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Using The Flight Heritage From >150 Electric Propulsion Systems To Design The Next Generation Field Emission Electric Propulsion Thrusters

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Abstract : In 2018 the NANO thruster became the first Field Emission Electric Propulsion (FEEP) system ever to be verified in space in an In-Orbit Demonstration mission conducted together with Fotec. Since then, 160 additional ENPULSION NANO propulsion systems have been deployed in orbit on 73 different spacecraft across multiple customers and missions. These missions included a variety of different satellite bus sizes ranging from 3U Cubesats to >100kg buses, and different orbits in Low Earth Orbit and Geostationary Earth orbit, providing an abundance of on orbit data for statistical analysis. This large-scale industrialization and flight heritage allows for a holistic way of gathering data from testing, integration and operational phases, deriving lessons learnt over a variety of different mission types, operator approaches, use cases and environments. Based on these lessons learnt a new generation of propulsion systems is developed, addressing key findings from the large NANO heritage and adding new capabilities, including increased resilience, thrust vector steering and increased power and thrust level. Some of these successor products have already been validated in orbit, including the MICRO R3 and the NANO AR3. While the MICRO R3 features increased power and thrust level, the NANO AR3 is a successor of the heritage NANO thruster with added thrust vectoring capability. 5 NANO AR3 have been launched to date on two different spacecraft. This work presents flight telemetry data of ENPULSION NANO systems and onorbit statistical data of the ENPULSION NANO as well as lessons learnt during onorbit operations, customer assembly, integration and testing support and ground test campaigns conducted at different facilities. We discuss how transfer of lessons learnt and operational improvement across independent missions across customers has been accomplished. Building on these learnings and exhaustive heritage, we present the design of the new generation of propulsion systems that increase the power and thrust level of FEEP systems to address larger spacecraft buses.

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